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Knowledge as a facilitator for enhancing innovation performance through total quality management

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Many organisations are facing competitive challenges due to the rapid pace of technological change. Management theorists and practitioners alike have called for more creativity and innovation in product lines, management practices and production processes. However, total quality management (TQM) has long been a major management practice. Knowledge management (KM) initiatives have gained popularity in organisations recently. In addition, innovation has also received considerable attention as critical to securing sustainable competitive advantage in the marketplace. This study examined how KM initiatives, TQM and innovation performance are related. A survey of 223 managers from 1139 Taiwanese high-tech companies provided the empirical data needed. The study used structural equation modelling to analyse simultaneously the relationships between KM, TQM and innovation performance. Findings were that KM is positively associated with both TQM and innovation performance and that TQM is a mediator between KM and innovation performance.

Keywords: knowledge management; total quality management; innovation

Introduction

Total quality management (TQM) has long been a major management practice. Recognition of TQM as a competitive advantage is widespread around the world, and few companies can afford to ignore TQM (Dean & Bowen, 1994). Empirical studies assessing the relationship between TQM and organisational performance have indicated strong and positive results (Ahire, Golhar, & Waller, 1996; Flynn, Sakakibara, & Schroeder, 1995). One of TQM's greatest benefits is its emphasis on continuous improvement of business processes. The aim of TQM is to improve competitiveness, effectiveness and flexibility (Evans & Lindsay, 1998).

To achieve continuous improvement, firms must promote organisational learning to enhance knowledge that can be utilised in the future (Baker & Sinkula, 1999). Mukherjee, Lapre, & Van Wassenhove (1998) suggested that TQM is the primary connection between organisational achievement and change in knowledge structures. If companies can create, manage and apply organisational knowledge, they can sustain their competitive edge (Davenport & Prusak, 1998; Desouza & Evaristo, 2003). KM initiatives have, therefore, gained popularity in organisations (McAdam & Leonard, 2001).

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Innovation has also received considerable attention as critical to securing sustainable competitive advantage in the marketplace (Weerawardena, O'Cass, & Julian, 2006). Many organisations are facing competitive challenges owing to the rapid pace of technological change. Industries dependent on highly sophisticated technologies or competing globally are particularly vulnerable to the need for continuous and rapid alternations in organisational activities (Teece, 1998). Because of these conditions, management theorists and practitioners alike have called for more creativity and innovation in product lines, management practices and production processes (Damanpour, 1991; Ettlie, 1990; Parnaby, 1991).

Research purposes

Numerous authors have recognised the importance of the relationships between KM and innovation (Chourides, Longbottom, & Murphy, 2003; Darroch & McNaughton, 2002; Davenport & Prusak, 1998; Gopalakrishnan & Bierly, 2001; Hall & Andriani, 2003; Nonaka & Takeuchi, 1995; Yamin, Gunasekaran, & Mavonda, 1999). While studies have shown that KM can lead to innovation (Darroch & McNaughton, 2002; Forrester, 2000; Gopalakrishnan & Bierly, 2001), and some other studies have shown a relationship between TQM and innovation (Prajogo & Sohal, 2003; Roffe, 1998), few studies have investigated the relationship between KM, TQM and innovation, though the relationship seems obvious. KM and TQM, both major management practices, seem to be closely related (Hsu & Shen, 2005). What are the relationships between KM, TQM and innovation? Can KM initiatives implemented through TQM improve an organisation's capability for innovation? This study attempted to determine the role of KM implemented through TQM in organisational innovation. The purpose of this study was to explore the relationships between KM, TQM and organisational innovation performance.

Definitions

This section provides brief definitions of the three core concepts included in this study: knowledge management, total quality management and innovation performance.

Knowledge and knowledge management

No consensus currently exists on a definition of knowledge. Quinn, Anderson, & Finkelstein (1996) suggested that knowledge is professional intellect. According to Alavi and Leidner (2001), knowledge is meaning made by the mind; without meaning, knowledge is merely inert, static and disorganised information. Nonaka (1991) defined knowledge as justified belief, whereby beliefs are utilised to justify self-interest.

Knowledge management addresses changes in what an organisation collectively knows and how the organisation acts. For De Jarnett (1999), KM comprises knowledge creation, followed by knowledge interpretation, dissemination, use, retention and refinement. McAdam and Leonard (2001) posited that knowledge management is an activity focused on strategy and tactics utilised in managing human assets. Quintas, Lefrere, & Joues (1997) argued that KM is the process of critically managing knowledge to meet existing needs, identify and exploit existing and acquired knowledge assets, and develop new opportunities.

From a process point of view, researchers have identified many key aspects of the KM process: acquire, collaborate, integrate and experiment (Leonard, 1995); create, transfer,

assemble, integrate and exploit (Teece, 1998); create, transfer and use (Spender, 1996); create, store/retrieve, transfer and apply (Alavi & Leidner, 2001); and create, access, disseminate and apply (Nonaka & Takeuchi, 1995). An examination of the above characteristics enables the grouping of KM initiatives into knowledge creation, knowledge storage, knowledge transfer and knowledge application. These four elements in this study comprised the major concepts of KM.

However, knowledge creation was defined as improved use of existing knowledge and effective acquisition of new knowledge. The creation of organisational knowledge requires the sharing and dissemination of personal experience (Gold, Malhotra, & Segars, 2001). When knowledge is created, the mechanism of knowledge storage becomes important. How the knowledge is stored in a database influences the process of knowledge sharing and transfer (Lim & Klobas, 2000). Knowledge storage was defined as how an organisation captures and stores units of knowledge in forms that assign various labels, categories and indexes to the input (Zack, 1999). Knowledge transfer was defined as the business processes that distribute knowledge among all individuals participating in process activities (Lin & Lee, 2005). Knowledge application was defined as the business processes through which effective storage and retrieval mechanisms enable a firm to access knowledge easily (Lin & Lee, 2005).

Organisational innovation

Bates and Khasawneh (2005) suggested that innovation is equated with the adoption and application of new knowledge and practices, including the ability of an organisation to adopt or create new ideas and implement these ideas in developing new and improved products, services, and work processes and procedures. Innovation, then, is considered an intangible resource that is very difficult to imitate. Such resources constitute an organisational capital, a source of competitive advantage.

From the perspective of competency, organisations with innovative competency can transform employee knowledge and ideas into products and services tailored to customer needs and into creative production of goods and services. Such innovations are manifested in a new product, service, technology and administrative practice (Zaugg & Thom, 2003). Gopalakrishnan and Bierly (2001) categorised innovation into three typologies: administrative and technical innovations, product and process innovations, and radical and incremental innovations. Yamin et al. (1999) conceptualised organisational innovation as three dimensions – administrative, product and process innovations. Prajogo, Power, & Sohal (2004) identified two type of innovation performance – product and process. These classifications enable the grouping of organisational innovation into product innovation and process innovation.

Product innovations are outputs or services that are introduced for the benefit of customers or clients, while process innovations are tools, devices and knowledge in throughput technology that mediate between inputs and outputs (Ettlie, 1990). Additionally product innovations are usually aligned with a differentiation strategy, while process innovations aid the effective implementation of a low-cost strategy.

Total quality management

According to Grant, Shani, & Krishnan (1994), 'TQM comprises a group of ideas and techniques for enhancing competitive performance by improving the quality of products and processes' (p. 26). Since the early 1980s, TQM has had a profound impact on US

businesses. TQM is a company-wide philosophy of quality improvement. This philosophy contends that the firm's primary goal is to meet customer requirements better by improving the quality of products and processes.

Hermel (1997) stated that TQM has moved from a predominantly narrow and mechanistic focus to include a more subjective and broader organisational philosophy. This broader approach has led some scholars to refer to the key theoretical constructs of TQM, rather than devising succinct definitions. Thus, based on Dale, Wu, Zairi, Williams, & van der Wiele (2001), DeCock and Hipkin (1997), Hackman and Wageman (1995), Hermel (1997), McAdam and Leonard (2001) and Ross (1995), TQM is defined here as embodying the following principles: (1) TQM is strategically linked to organisational goals; (2) identifying customers and understanding their expectations, in order to achieve customer satisfaction, is vital within the organisation; (3) employee participation at all levels is required within the organisation; (4) top management is committed and has consistency of purpose; and (5) the aim of TQM is continuously to improve process performance in order to satisfy customer requirements. These five TQM principles can summarised as following four elements: top management support, employee involvement, continuous improvement and customer focus. These four elements comprised the major constructs of TQM in this study.

Literature review and hypotheses

This section includes a brief review of literature that has examined relationships among the three variables that are the focus of this study. Because of the limited number of studies that have explored these relationships, the literature is, of necessity, limited. Following the literature review, hypotheses that emerge from the literature and that are the focus of this study are provided.

Contributions of KM initiatives to innovation performance

KM is emerging as an important concept often cited as an antecedent of innovation (Darroch & McNaughton, 2002; Lin & Lee, 2005; Nonaka & Takeuchi, 1995). According to Gloet and Terziovski (2004), the humanist approach to KM and innovation performance are significantly and positively related, while IT-focused KM and innovation performance are not significantly and positively related. Gilbert and Cordey-Hayes (1996) argued that knowledge application is the facilitator of successful innovation. Lin and Lee (2005) confirmed, from an e-business perspective, that knowledge application positively impacts on innovation, while knowledge transfer does not significantly impact on innovation. Some studies, however, have confirmed that knowledge transfer is important in the innovation process (Cavusgil, Calantone, & Zhao, 2003; Hall & Andriani, 2003; Liebowitz, 2002; Nah, Siau, Tian, & Ling, 2002). Prajogo et al. (2004) confirmed that KM has a significant positive relationship to both product innovation and process innovation. Thus, the first hypothesis (*H1*) of this study is that KM initiatives have direct positive effect on innovation performance.

Contributions of KM initiatives to TQM

As Grover and Davenport (2001) noted, KM is rapidly becoming a critical business function and solution for many organisations in effectively managing intellectual resources. After a review of the TQM and KM literature, McAdam and Leonard (2001)

suggested that, during everyday business processes and operations, TQM and KM constitute an interactive relationship. Zhao and Bryar (2001) considered KM and TQM as strongly linked, particularly in the areas of continuous improvement and workforce empowerment. Snyder and Cummings (1998) stated that organisations must be able to learn from experience, effectively use knowledge, correct errors, and apply this knowledge within the organisation if they are to change and adapt to continuously changing markets. That is, through KM initiatives, TQM as a philosophy or management practice can assist organisations in cultivating their ability to change and continuously improve.

During organisational change, the roles of TQM and KM are usually very similar. Huselid (1995) argued that, when systems empower employees during quality improvement initiatives, their knowledge and skills are applied more easily. Consequently, these systems create opportunities for employees to disseminate their knowledge throughout an organisation. Thus, the second hypothesis (*H2*) is that KM initiatives have a direct positive effect on TQM.

Contributions of TQM to innovation performance

A review of literature examining the relationships between TQM and innovation indicated that conflicting arguments exist concerning the relationship between TQM and innovation (Prajogo & Sohal, 2003). Arguments proposing a positive relationship between TQM and innovation posited that companies implementing TQM in their business systems and corporate culture are fertile environments for innovation because TQM promotes principles coincident with innovation (Prajogo & Sohal, 2003; Roffe, 1998). A focus on meeting customer needs encourages organisations continually to identify new customer needs and expectations, thereby inducing organisations to innovate, that is, continually develop and introduce products that meet a market's changing needs. Continuous improvement also requires change and creative thinking in how work is being organised and conducted. Finally, top management support and employee involvement are also critical to successful organisational innovation.

Conversely, several scholars have rejected this positive relationship between TQM and innovation, arguing that TQM promotes principles and practices that hinder innovation. For example, Slater and Narver (1998) argued that a customer-focused philosophy can easily cause organisations to focus only on incremental improvements to current products and service activities rather than creating novel solutions. Most of the time, novel solutions lead to the development of real innovation. Consequently, a customer-focused philosophy may not lead to real innovation. Therefore, firms employing such a philosophy may not identify the latent needs of customers. As a result, these companies fail to foster generative learning by searching for unserved customers or untapped potential markets. Similarly, continuous improvement, as one TQM construct in this study, requires internal regulatory standards and activities that are routine and well understood by everyone in the company. Hence, control and its stability are at the centre of the continuous improvement process (Jha, Noori, & Michela, 1996). From an innovation perspective, although standardisation of organisational process is necessary for conformance and error reduction in production, employees can become trapped by established business practices (Glynn, 1996).

Despite these criticisms of TQM's impact on innovation, many empirical studies (Prajogo & Sohal, 2003; Roffe, 1998; Taveira, James, Karsh, & Sainfort, 2003; Young, Charns, & Shortell, 2001) have confirmed the positive relationship between TQM and innovation. A goal of this study was to understand the nature of this relationship. Thus, the authors proposed a third hypothesis (*H3*): TQM has a direct positive effect on

innovation performance. In addition, the authors also proposed a fourth hypothesis (*H4*): KM initiatives have an indirect effect on innovation performance via the mediator, TQM.

Methods

This study employed a survey research method to examine the hypothesised relationships among knowledge management, total quality management and organisational innovation performance. A self-administered survey sampled Taiwanese high-tech industry companies.

Population

The population for this study consisted of the top 1139 Taiwanese companies in the high-tech industry based on their market capitalisation; a database, the *2004 Taiwanese top 5000 companies*, compiled by the China Credit Information Service (CCIS) (CCIS, 2004), provided the listing of companies. CCIS is a leading credit analysis research firm in Taiwan, similar to Standard & Poor's and Moody's in the United States.

Mintzberg and Waters (1985) believed that top administrators provide reliable information regarding the basic environmental and organisational characteristics of their organisations. The researchers thus mailed the questionnaire plus covering letter and pre-paid reply envelope to the managing director or chief executive officer of each company in the population.

There were 235 responses during the six-week period following the distribution of the questionnaires. Incomplete data rendered 12 responses not usable, yielding 223 usable surveys, for a response rate of 19.6%. This response rate compares favourably with other surveys in related management fields, where response rates have ranged between 10% and 32% (Cavusgil et al., 2003; Gold et al., 2001). In spite of the above average response rate, readers must exercise caution in interpreting the data, recognising the high likelihood that respondents differ in some significant ways from non-respondents.

Measures

Consistent with the above discussion, the survey instrument consisted of items representing the three constructs of importance to this study.

Knowledge management initiatives

Twelve items assessed knowledge management processes. Each construct dimension in KM consisted of three items. To measure knowledge creation, the researchers adapted Gold et al.'s (2001) items, with a reliability estimate of 0.85. To measure knowledge storage, the researchers adapted Al-Busaidi and Olfman's (2005) items, with a reliability estimate of 0.93. To measure knowledge transfer and knowledge application, the researchers adapted Lin and Lee's (2005) items, with reliability estimates of 0.79 and 0.81, respectively. Respondents indicated their level of agreement with descriptive statements using a five-point Likert-type scale (1 = strongly disagree to 5 = strongly agree).

Cronbach's alpha was used to measure the internal consistency of the measurement scale. Reliability coefficients for the four dimensions were 0.61, 0.71, 0.78 and 0.70, respectively, with an overall Cronbach's alpha of 0.87. An adequate alpha is one that is higher than 0.50, though Nunnally (1978) recommended an alpha higher than 0.60. Hence, the measurement instrument is reliable. The overall Cronbach's alpha was 0.87, comparable with previous studies (Al-Busaidi & Olfman, 2005; Lin & Lee, 2005). As

the scale items had been used previously, the confirmatory factor analysis (CFA) resulted in a reasonable fit for the four-dimensional model of KM (χ^2 (48) = 88.14, $p < 0.001$; RMR = 0.03, GFI = 0.94, NFI = 0.92, CFI = 0.96).

Total quality management

This study used 16 items to assess TQM, with four items for each of the four dimensions: top management support, employee involvement, continuous improvement and customer focus. To measure employee involvement, the researchers adapted items used by Powell (1995). To measure top management support, continuous improvement and customer focus, the researchers adapted items from Zeitz, Johannesson, & Ritchie (1997), with reliability estimates of 0.88, 0.79 and 0.69, respectively.

A five-point Likert-type scale (1 = strongly disagree to 5 = strongly agree) indicated level of agreement. Reliability coefficients for the four dimensions were 0.86, 0.83, 0.79 and 0.81, respectively, with an overall alpha of 0.89, all moderately strong. The CFA, used because these items came from previous studies, demonstrated a reasonable fit using the four-dimensional factor structure (χ^2 (98) = 386.46, $p < 0.001$; RMR = 0.04, GFI = 0.91, NFI = 0.83, CFI = 0.86).

Innovation performance

Eleven items measured the innovation performance construct, all adapted from Prajogo et al. (2004). The reliability estimates for product innovation and process innovation were 0.87 and 0.89, respectively, both exceeding the criterion for minimal acceptance. The items fell into four categories: the number of innovations, the speed of innovation, the level of innovativeness, and being the first in the market. Respondents provided their perceptions of the company's innovation performance against major competitors in the industry to minimise industry effects. Kraft (1990) discussed the advantage of this approach in detail.

In this study, each item used a five-point response scale that ranged from 1 (strongly disagree) to 5 (strongly agree). Six items determined product innovation performance (reliability estimate, 0.89), and five items measured process innovation performance (reliability estimate, 0.85). For this study, CFA results indicate a moderate fit for the three dimensions of organisational innovation performance (χ^2 (101) = 372.90, $p < 0.001$; RMR = 0.04, GFI = 0.83, NFI = 0.85, CFI = 0.88).

Data analysis

The researchers used structural equation modelling (SEM), a multivariate statistical analysis technique used to study thoroughly proposed theories, to explore the proposed relationships (Jöreskog & Sörbom, 1996). Testing of the hypotheses regarding the relationships among specific constructs considered measurement errors. Furthermore, this analysis allows both endogenous variables (underlying dependent variables) and exogenous variables (external predictors) to be examined. Numerous measures or indices determined the fit of the model under examination. Data analysis results and established standards for fit estimation determined the veracity of the findings compared with the proposed model. A solid SEM model can account for the observed covariance structure.

This study estimated the hypothesised structural equation model (Figure 1) using Amos 4.0 software. Latent variables used in the analysis were knowledge management

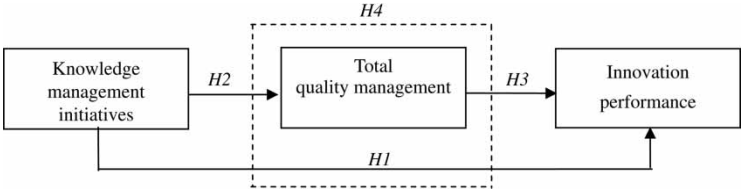

Figure 1. Conceptual framework.

initiatives, total quality management and innovation performance. The following indices determined the overall model and data fit: chi-square analysis; incremental fit index (IFI) (Bollen, 1989); comparative fit index (CFI) (Bentler, 1990); and root mean squared residuals (RMR) (Jöreskog & Sörbom, 1996). Both incremental indices compared the fit of the hypothesised model with that of the null baseline model. Each incremental fit index ranges from 0 to 1.0; a value exceeding 0.90 indicates acceptable model-data fit.

In addition to fit indices, this study reports parameter estimates based on associated significance levels for the hypothesised model to identify adequate items for the study constructs. Squared multiple correlations identified the predictive power of the hypothesised conceptual model for the key endogenous variables. Squared multiple correlations for a latent variable indicate the percentage of variation in that construct that is explained using the proposed model.

Results

The patterns of correlations (Table 1) in this study generally supported the proposed hypotheses. All 11 indicators for the constructs in this study exhibited statistically significant correlations, demonstrating moderate to high correlations among KM initiatives, TQM and organisational innovation performance. SEM analysed the direct and indirect effects of KM initiatives on organisational innovation performance.

Results of SEM testing of the model (Figure 2) demonstrated that the proposed model generally fits closely with the sample data: χ^2 (41) = 128.20, $p < 0.001$; RMR = 0.02, GFI = 0.91, IFI = 0.95, CFI = 0.95. The values of the two incremental fit indices demonstrated adequate model-data fit (IFI = 0.95, CFI = 0.95), and the hypothesised model had a relatively small residual (RMR = 0.02). The square of the multiple correlations for the construct of organisational performance was 0.65, suggesting that the proposed model explained 65% of the variance in the construct.

According to Baron and Kenny's (1986) recommendations for examining mediating effects, three conditions should be fulfilled: the first condition is that the independent variable and proposed mediator must each be significantly related to the dependent variable when considered separately. The preceding analysis demonstrated that the independent variable (KM) was independent of the proposed mediator (TQM), and both were significantly related to the dependent variable (innovation performance) separately. The second condition requires the independent variable to be significantly related to the proposed mediator. The preceding analysis also demonstrated that the independent variable (KM) was significantly related to the proposed mediator (TQM). Furthermore, all structural paths (Figure 2) in the proposed model also yielded significant parameter estimates. Combined, these analytical results supported the proposed model and Hypotheses 1–3. The last condition specifies that the relationship between the independent variable and the dependent variable should be diminished or non-significant when the proposed

Table 1. Means, standard deviations, and correlations of measures (N = 223).

Variable	M	SD	KM1	KM2	KM3	KM4	TQM1	TQM2	TQM3	TQM4	IN1
KM1	3.7241	0.5812									
KM2	3.8034	0.6301	0.583**								
KM3	3.6569	0.6983	0.627**	0.625**							
KM4	3.6178	0.6353	0.607**	0.634**	0.702**						
TQM1	3.9176	0.6180	0.383**	0.415**	0.441**	0.385**					
TQM2	3.6841	0.6289	0.444**	0.416**	0.544**	0.407**	0.763**				
TQM3	3.8114	0.5558	0.340**	0.409**	0.463**	0.309**	0.641**	0.729**			
TQM4	3.7647	0.5885	0.403**	0.485**	0.545**	0.420**	0.581**	0.621**	0.682**		
IN1	3.4628	0.6478	0.350**	0.366**	0.398**	0.309**	0.517**	0.484**	0.505**	0.550**	
IN2	3.5267	0.6677	0.387**	0.412**	0.513**	0.359**	0.537**	0.594**	0.561**	0.583**	0.809**

Notes: KM1 = knowledge creation, KM2 = knowledge storage, KM3 = knowledge transfer, KM4 = knowledge application, TQM1 = top management support, TQM2 = employee empowerment, TQM3 = continuous improvement, TQM4 = customer focus, IN1 = product innovation performance, IN2 = process innovation performance.
**$p < 0.01$.

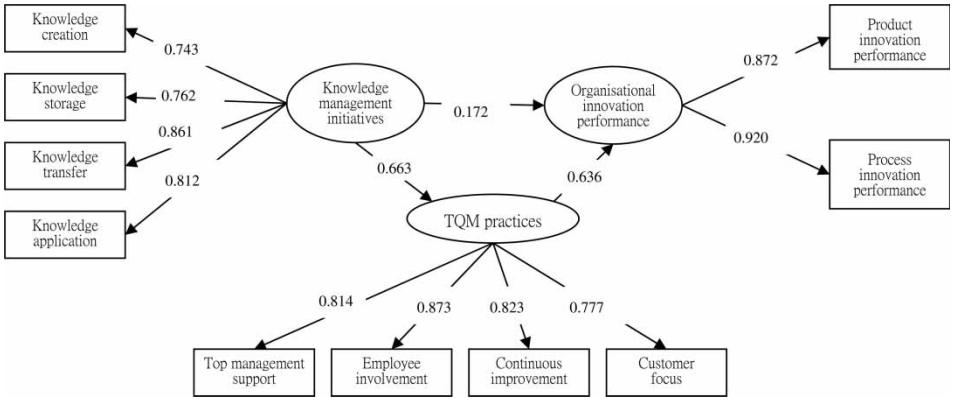

Figure 2. Structural equation model for organisation innovation performance.

mediator is considered. In this study, analytical results demonstrated that TQM mediates between KM initiatives and organisational innovation performance. Although KM is positively associated with innovation performance (as indicated by Hypothesis 1), this relationship was less with TQM as a mediating variable. Table 2 demonstrates that the relationship between KM and innovation performance is direct and statistically significant, though the correlation is low in absolute size ($r = 0.172$, $p < 0.001$); the indirect effect of KM on innovation performance through TQM is significant and considerably stronger ($r = 0.422$, $p < 0.001$). The results support the fourth hypothesis that TQM mediates the relationship between KM and innovation performance.

Analytical results of this study also indicated that knowledge transfer ($\lambda x3 = 0.861$) is a factor crucial to the process of KM initiatives, followed by knowledge application ($\lambda x4 = 0.812$), knowledge storage ($\lambda x2 = 0.762$), and knowledge creation ($\lambda x1 = 0.743$). Within TQM practices, employee involvement ($\lambda y2 = 0.873$) is a factor essential to TQM success, and process innovation ($\lambda z3 = 0.861$) is a key factor for organisational innovation performance.

Structural equation models generally apply ellipses to represent constructs (latent variables), and a line with one arrow between two constructs signifies the influence of one construct on another. The number contiguous to the line is the statistic denoting standardised

Table 2. Total effects of knowledge management initiatives on total quality management and innovation performance.

			Dependent variable (endogenous variables)	
Independent variable			Total quality management	Innovation performance
Exogenous variables	Knowledge management initiatives	Direct effect	0.663***	0.172***
		Indirect effect	–	0.422***
		Total effect	0.663***	0.594***
Endogenous variables	Total quality management	Direct effect		0.636***
		Indirect effect		–
		Total effect		0.636***

Note: ***$p < 0.001$.

path coefficients (SPC) and can be considered a standardised regression coefficient for one latent variable in relation to another when the effects of all other variables are eliminated. This study suggests that KM initiatives significantly and positively contribute to TQM success (SPC = 0.663, $p < 0.001$). Furthermore, the KM initiatives positively influence, though to a small degree, organisational innovation performance (SPC = 0.172, $p < 0.001$). Finally, TQM significantly contributed to innovation performance (SPC = 0.636, $p < 0.001$). Furthermore, analytical results also demonstrate that TQM plays a key meditating role in transforming the contributions of KM initiatives into innovation performance.

Conclusions and discussion

Previous studies typically examined KM initiatives and TQM individually. This study is the first of which the authors are aware to investigate how firms' KM initiatives influence innovation performance through TQM practices. Analytical results of this investigation demonstrate that the proposed structural model closely fits sample data. The empirical data partially supported the tested hypotheses. Analytical results obtained by this study are consistent with those in current literature that have demonstrated that KM initiatives significantly and positively contribute to TQM (McAdam & Leonard, 2001; Zhao & Bryar, 2001). Study findings are also consistent with those in the literature that state that TQM positively and significantly contributes to innovation (Prajogo & Sohal, 2003; Roffe, 1998), partially answering the controversy about whether TQM initiatives support or inhibit innovation.

Although KM initiatives significantly affected innovation performance in this study, their influence was small unless mediated by TQM. Restated, KM initiatives in firms do not appear to deliver or create value directly. KM alone does not generate superior performance. Instead, organisations have to use what they have learned in the appropriate way, such as through total quality management practices, to make them effective. Given these results, with the direct effectiveness of KM remaining unknown, organisations may choose to invest in the direct mediating process of TQM rather than in knowledge management activities.

TQM is more strongly associated with KM initiatives and innovation performance. Although KM and TQM share some basic principles, TQM contains more crucial factors than KM, such as continuous improvement. Therefore, TQM becomes a mediator for KM to improve innovation performance.

Limitations and future research

The study had some limitations. Because the study comprised only high-tech firms, the study ruled out extraneous factors associated with different organisations in different industries; thus, care is required in generalising the results to other business organisations. This study also did not objectively measure organisational performance. Future studies are required that include a broad sample of firms from other industries and some objective assessments of organisational performance, such as those conducted by Ellinger, Ellinger, Yang, & Howton (2002). Another limitation is that all measures used the same method (self-report); relationships among variables might be inflated by common method variance. Future research should be designed to avoid these limitations.

Implications for practice

Besides the research and theoretical implications, this study provides practical implications for business and highlights management issues involving knowledge management initiatives and understanding of the influence of total quality management on

organisational innovation performance. This study proposes that senior management is likely to gain more from using its resources for TQM than for KM, if the goal is innovation, especially in high-tech companies in Taiwan.

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